

15th, and on the Texas coast on the 30th. These warnings were justified by subsequent conditions, and no general storm occurred without warning.—*I. M. Cline.*

DENVER FORECAST DISTRICT.

On the morning of the 1st, freezing weather in western Colorado, with temperatures as low as 22° in the elevated portions of northern Arizona and southern Utah attended an area of moderately high pressure whose crest was over the last-named State. A HIGH which moved with increasing intensity from the north Pacific coast on the 2d to South Dakota and Nebraska on the 4th was attended by light showers in eastern Colorado on the 3d and by killing frosts in the northeastern portion of this State on the morning of the 4th. Occasional showers in the northern portions of the district on the 5th, and also in Colorado on the 6th, attended a LOW which advanced northeastward from Arizona on those dates. The succeeding HIGH which overspread the northern Rocky Mountain States on the 6th and 7th was attended by freezing temperature in north-central Arizona on the 7th and 8th and by frosts in extreme northeastern Colorado on the 8th, when the crest of the HIGH was over the Dakotas. Showery conditions in northern Colorado on the 10th, 11th, and 12th, and in about all of the district on the 13th and 14th, resulted from two separate disturbances which advanced eastward from Arizona. Frost occurred in north-central Arizona, north-central New Mexico, and southeastern Colorado, and freezing temperatures in north-central Colorado on the 15th, followed by killing frosts and freezing temperatures in northeastern Colorado on the 16th, due to an area of high pressure which developed over the Northern Rocky Mountain States on the 14th and moved southeastward to western Kansas and northwestern Texas by the morning of the 16th. Low pressures prevailed in most of the Rocky Mountain region from the 16th to the 31st, with scattered showers and thunderstorms in Colorado and occasionally in Utah. During the 31st the Plateau LOW advanced with increasing intensity from Utah to southeastern Wyoming, where it recurved to the northwestward, its center on the following morning being over extreme northern Idaho. This unusual action of the disturbance was followed by a sharp fall in temperatures in extreme western Colorado, northern Arizona, and southern Utah, amounting to a local cold wave at Flagstaff, where the minimum temperature was 24°. The lowest temperature on record for the first decade in June, 22°, occurred at Modena.

Frost warnings were issued almost daily for some part of the district, especially the higher elevations, from the 1st to the 15th and again from the 21st to the end of the month.

As a rule the frost and freezing temperature warnings distributed were verified.—*J. M. Schrier.*

SAN FRANCISCO FORECAST DISTRICT.

No severe storms visited this district during the month. Storms moving southeastward from the north Pacific passed inland at a high latitude, and thence either eastward through Canada or southward along the western slope of the Rocky Mountains to Arizona and New Mexico and then east. On one or two occasions storms developed over the southern Plateau and moved eastward.

While the storms passed inland too far north to cause gales along the northern coast, they gave frequent

showers in the North Pacific and Plateau States. The showers were generally light and in some instances were accompanied by thunderstorms. No damage was reported either from heavy rain or lightning.

No severe frosts occurred in the fruit centers, and the special fruit-frost service closed for the season in all portions of this district during the latter part of the month.

No storm warnings were issued during the month.

Live-stock warnings were issued in eastern Washington, eastern Oregon, and Idaho on the 25th. They were timely and verified.—*G. H. Willson.*

RIVERS AND FLOODS.

By H. C. FRANKENFIELD, Meteorologist.

While nearly all the rivers east of the Mississippi River, except those of the Middle Atlantic system, were in flood at some time during the month of May, the floods were short and moderate for the most part, except in the Tombigbee River of Alabama, which, below the mouth of the Black Warrior River, had been in flood almost continuously since March 23, with a crest stage of 51.4 feet, or 12.4 feet above flood stage, on March 30. The highest stage reached in May was 47.2 feet on the 22d, and the river did not fall below the flood stage until June 6, another crest of 46.9 feet having been reached on June 3. Damage and loss amounted to about \$16,000, while partial returns showed a saving of \$10,700 through the warnings issued.

As the interval between the April and May floods in the Pearl River of Mississippi had been so short, farming and stock operations had not been undertaken, and there was therefore little or no damage done, but logging and sawmill operations continued inactive through virtually all of May and the losses were very heavy.

The floods in the Wabash and White Rivers of Indiana, while moderate, overflowed more than 5,000 acres of corn and wheat and caused losses in prospective crops of about \$31,000, and other property losses of about \$3,000. The value of property saved through the warnings was about \$23,000. One life was lost near Prairietown, Ind.

The Yazoo River of Mississippi remained in flood throughout the month.

Warnings for all floods were issued at the proper time.

A severe flood occurred in the Ouachita River in Arkansas during the third week of the month. It was caused by a 48-hour rainfall of from 5 to 8 inches, and although warnings were issued as soon as information of the heavy rain was received, it was impossible in some localities to effect the entire removal of live stock and other portable property. At Arkadelphia, Ark., the Ouachita River rose from 2 to 23 feet during the 24 hours ending at 7 a. m. May 15. This crest stage of 23 feet was 5 feet above the flood stage and 0.4 foot above the previous high-water mark of May 12, 1920. At Camden, Ark., the crest stage on May 18 was 9.9 feet above the flood stage of 30 feet. Below Arkadelphia the rainfall was not so heavy, and flood stages were not reached south of the Arkansas-Louisiana boundary. One colored man was drowned, 2,000 acres of farm lands were overflowed, and 600 head of live stock were lost. Crop losses were about \$50,000 and those of live stock \$10,000, mostly in the vicinity of Arkadelphia. Below this place there was time after the receipt of the warnings to remove stock, etc., and no losses were reported.

Shortly after the middle of May a series of heavy rains set in over the Arkansas and Canadian River Valleys in eastern Colorado, Kansas, Arkansas, Oklahoma, and extreme northwest Texas, and within a few days the Arkansas River below Wichita, Kans., and all tributaries to the southward were in flood. The floods continued at the close of the month and became very dangerous and destructive during the first half of June. A description of these floods will appear in the MONTHLY WEATHER REVIEW for June, 1923.

Local floods in the rivers of Texas were unimportant. The Solomon River of Kansas was in moderate flood above Niles, Kans., from May 24 to 27, inclusive, following a 48-hour rain of from 2.50 to 3.75 inches. At Beloit, Kans., the crest stage on May 25 was 28.8 feet, 10.8 feet above the flood stage, and at Niles, Kans., 24.4 feet on May 30, or 1.6 feet below the flood stage.

Warnings were issued as soon as possible, and losses and damage were limited to \$17,500, of which \$12,000 was in prospective crops. The losses were confined to Mitchell County, and the value of the property saved was \$1,000.

Generous rains in western Nebraska brought the North Platte River at North Platte to the flood stage of 5 feet on May 29. The rise was devoid of special incident.

The rise in the upper Colorado River and tributaries in Colorado, Wyoming, and Utah began early in the month, and the first warnings were issued on May 4 for the North Fork of the Gunnison River of Colorado. The floods gradually extended throughout the main stream, although flood stage was not reached much below Parker, Ariz. Warnings of the flood progress were issued frequently and no damage was reported.

The Rio Grande was continuously in moderate flood in the vicinity of San Marcial, N. Mex., after May 6, with a crest stage of 2.1 feet, or 1.1 feet above flood stage, on May 15. Warnings were issued at various times and no damage was reported.

The annual rise of the Columbia River was in progress at the close of the month, the flood stage of 24 feet having been reached at Marcus, Wash., the outpost station, on May 27. The river was also in flood at Vancouver, Wash., on the following day, the flood waters overflowing into the Willamette River at the same time, bringing the latter to flood stage. Report on this flood will be made later.

Flood stages during May, 1923.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
ATLANTIC DRAINAGE.					
Connecticut:	<i>Fect.</i>			<i>Fect.</i>	
White River Junction, Vt.....	13	(1)	5	22.0	
Hartford, Conn.....	16	(1)	6	20.4	
Cape Fear:					
Elizabethtown, N. C.....	22	2	2	23.0	
Santee:					
Rimini, S. C.....	12	9	12	12.9	1
Do.....	12	19	21	12.7	2
Do.....	12	25	(2)	13.3	2
Ferguson, S. C.....	12	10	14	12.3	12-1
Do.....	12	21	22	12.1	2
Do.....	12	27	(2)	12.8	30-3
Saluda:					
Pelzer, S. C.....	7	29	(2)	7.7	3
Broad:					
Carlton, Ga.....	11	29	(2)	17.0	3
Oconee:					
Milledgeville, Ga.....	22	6	7	29.0	
Do.....	22	28	28	24.6	
Do.....	22	31	(2)	25.2	
Ocmulgee:					
Macon, Ga.....	18	27	28	20.6	
Do.....	18	30	(2)	20.1	
Abbeville, Ga.....	11	10	13	12.1	
Do.....	11	23	24	11.4	23-5
Do.....	11	29	(2)	12.6	

¹ Continued from April.

Flood stages during May, 1923—Continued.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
EAST GULF DRAINAGE.					
Apalachicola:	<i>Fect.</i>			<i>Fect.</i>	
River Junction, Fla.	13	8	9	12.0	8-9
Do.	12	19	20	12.5	19
Do.	12	29	(2)	16.0	31
Cahaba:					
Centerville, Ala.	25	16	16	27.0	16
Tombigbee:					
Lock No. 4, Ala.	30	2	11	43.9	7-8
Do.	39	17	15	47.2	22
Pearl:					
Jackson, Miss.	20	19	26	23.0	21
Do.	20	29	29	20.1	29
Do.	20	31	(2)	20.1	31
Columbia, Miss.	18	27	(2)	20.5	28
West Pearl:					
Pearl River, La.	13	(1)	5	14.4	2
Do.	13	17	(2)	15.2	19
GREAT LAKES DRAINAGE.					
Maumee:					
Fort Wayne, Ind.	15	15	18	17.4	17
Pine:					
Alma, Mich.	7	17	18	7.7	17
Cass:					
Vassar, Mich.	14	18	19	15.2	18
MISSISSIPPI DRAINAGE.					
Tuscarawas:					
Coshocton, Ohio.	8	13	16	11.6	13
Walhonding:					
Walhonding, Ohio.	8	13	13	12.3	13
Scioto:					
Larue, Ohio.	11	13	14	13.5	13
Do.	11	16	16	12.0	16
Prospect, Ohio.	10	13	14	11.8	14
Olentangy:					
Delaware, Ohio.	9	13	13	11.1	13
Wabash:					
Bluffton, Ind.	12	15	15	12.0	15
La Fayette, Ind.	11	14	20	17.7	17-18
Terre Haute, Ind.	16	19	22	17.2	21
Vincennes, Ind.	14	21	25	14.6	24
Mount Carmel, Ill.	16	19	25	18.6	23
West Fork of White:					
Elliston, Ind.	19	16	21	24.1	19
Edwardsport, Ind.	10	16	24	17.3	20
Do.	10	29	(2)	11.1	31
French Broad:					
Penrose, N. C.	13	30	(2)	15.3	30
Asheville, N. C.	4	29	31	5.0	29
Illinois:					
Peru, Ill.	14	19	20	14.0	19-20
Henry, Ill.	7	22	24	7.1	22-24
Beardstown, Ill.	12	28	28	12.0	28
Do.	12	30	30	12.0	30
St. Francis:					
Marked Tree, Ark.	17	19	(2)	19.1	28-31
Arkansas:					
Fort Smith, Ark.	22	24	30	26.1	25
Dardanelle, Ark.	20	25	(2)	25.0	26
Little Rock, Ark.	23	27	27	23.0	27
Pine Bluff, Ark.	25	28	(2)	25.6	29
Neosho:					
Yonkers, Okla.	14	26	27	20.1	27
North Canadian:					
Woodward, Okla.	3	16	16	3.3	16
Do.	3	22	26	7.7	23
Do.	3	30	30	3.2	30
Canton, Okla.	4	22	25	6.7	24
Oklahoma City, Okla.	12	22	22	12.1	22
Do.	12	27	(2)	15.9	28
Petit Jean:					
Danville, Ark.	20	(1)	1	21.2	1
Do.	20	15	19	24.9	16
Do.	20	24	29	23.1	26
White:					
Calico Rock, Ark.	18	16	17	18.1	16
Do.	18	26	26	18.7	26
Batesville, Ark.	23	15	18	25.6	15
Do.	23	26	28	27.0	26-27
Newport, Ark.	26	17	22	28.7	19
Do.	26	26	(2)	29.0	28
Georgetown, Ark.	22	18	(2)	25.9	31
Clarendon, Ark.	30	30	(2)	30.1	31
Black:					
Black Rock, Ark.	14	6	(2)	24.3	16
Cache:					
Patterson, Ark.	9	15	(2)	10.7	26-28
Yazoo:					
Yazoo City, Miss.	25	(1)	(2)	30.1	1
Tallahatchie:					
Swan Lake, Miss.	25	(1)	(2)	29.0	26
Sulphur:					
Ringo Crossing, Tex.	20	5	5	21.2	5
Ouachita:					
Arkadelphia, Ark.	18	15	16	23.0	15
Camden, Ark.	30	18	23	39.9	18

² Continued into June.

³ June.

Flood stages during May, 1923—Continued.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
MISSISSIPPI DRAINAGE—continued.					
Atchafalaya:	<i>Fcet.</i>			<i>Fcet.</i>	
Melville, La.....	37	(1)	1	37.0	1
North Platte:					
North Platte, Nebr.....	5	29	29	5.0	29
Solomon:					
Beloit, Kans.....	18	24	27	28.8	25
Trinity:					
Dallas, Tex.....	25	(1)	5	31.0	3
Trinidad, Tex.....	28	(1)	9	33.0	1
Liberty, Tex.....	25	6	6	25.0	6
Colorado (Texas):					
Columbus, Tex.....	28	2	2	28.0	2
Rio Grande:					
San Marcial, N. Mex.....	1	7	19	2.1	15
Do.....	1	21	(2)	1.7	31
Colorado:					
State Bridge, Colo.....	9	25	(2)	10.7	28
Fruita, Colo.....	12	20	29	12.3	29
Lees Ferry, Ariz.....	12	7	(2)	17.3	31
Topock, Ariz.....	14	15	18	15.0	17
Do.....	14	27	28	14.2	28
Do.....	14	31	(2)	14.3	31
Parker, Ariz.....	7	11	(2)	9.1	28-29, 31
North Fork of Gunnison:					
Paonia, Colo.....	9	8	12	9.4	10-11
Do.....	9	21	22	9.0	21-22
Do.....	9	26	28	9.0	26-28
Green:					
Elgin, Utah.....	12	27	(2)	13.0	31
PACIFIC DRAINAGE.					
Kings:					
Piedra, Calif.....	12	16	17	12.3	16
Columbia:					
Marcus, Wash.....	24	27	(2)	24.4	30-31
Vancouver, Wash.....	15	28	(2)	16.7	30
Willamette:					
Portland, Oreg.....	15	29	(2)	16.0	31

¹ Continued from April.² Continued into June.**MEAN LAKE LEVELS DURING MAY, 1923.**

By UNITED STATES LAKE SURVEY.

[Detroit, Mich., June 11, 1923.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes. ¹			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during May, 1923:	<i>Fcet.</i>	<i>Fcet.</i>	<i>Fcet.</i>	<i>Fcet.</i>
Above mean sea level at New York.....	601.65	579.60	571.87	245.62
Above or below—				
Mean stage of April, 1923.....	+0.26	+0.42	+0.56	+0.29
Mean stage of May, 1922.....	-0.27	-0.80	-0.87	-0.93
Average stage for May, last 10 years..	-0.49	-1.13	-0.97	-1.07
Highest recorded May stage.....	-1.40	-3.92	-2.55	-3.33
Lowest recorded May stage.....	+0.83	+0.04	+0.56	+0.66
Average relation of the May level to:				
April level.....		+0.30	+0.40	+0.30
June level.....		-0.20	-0.20	-0.20

¹ Lake St. Clair's level: In May, 574.55 feet.**EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS, MAY, 1923.**

By J. B. KINCER, Meteorologist.

There was entirely too much rainfall for agricultural interests during the month in the Southern States from the Mississippi River eastward, and rain was heavy to excessive in the west-central Great Plains. It was deficient in the middle Atlantic coast area and much of the Northeast, and there was less than the normal amount

in nearly all sections west of the Rocky Mountains. Unusually heavy snow for the season fell in southern Michigan and in some adjoining sections of Indiana and Ohio, more than 10 inches being reported from some stations in Michigan. The month as a whole averaged cool for the season in the central Plains and generally so east of the Mississippi River, but elsewhere the monthly mean temperatures were near normal.

Winter wheat made fairly good progress during the month throughout the principal producing sections. The crop made some improvement in the Ohio Valley States, but continued in poor condition in some localities, especially in parts of Ohio and Indiana. Progress was satisfactory in the trans-Mississippi States, although the crop was very late and threatened with weeds in western Kansas, because of the frequent heavy rainfall following the long drought, with resultant thin stands. The month was generally favorable in the Spring Wheat Belt and that crop was reported as growing nicely in most sections, except in Iowa, where it was in only fair condition. Wheat came up to a good stand and was of good color in North Dakota and in satisfactory condition in Montana.

Oats were short and needed more moisture in Iowa, but the crop improved during the month in the Ohio Valley area, although it was too dry in parts of Illinois. Warmer weather and more sunshine were needed for corn in much of the interior of the country. Germination was slow and much replanting was necessary in Iowa and Kentucky, where planting was considerably delayed; the warmer weather near the close of the month, however, improved conditions in the eastern portion of the Corn Belt. Planting was hindered by wet soil in the central Great Plains, and there was considerable damage by heavy, washing rains on bottomlands in Oklahoma the latter part of the month.

The weather was unfavorable for cotton. Heavy and persistent rains fell in the eastern portion of the belt, where the excessive moisture and cool weather retarded germination and growth, and greatly interfered with cultivation. Much of the month was too cloudy, cool, and wet also in the northwestern portion of the belt, but conditions were more favorable in Texas, where cotton made fair to very good progress. The weather was more favorable also in the Carolinas, where field work as a rule made very good progress, but growth of cotton was rather slow because of the cool weather.

Pastures were short in the Central States east of the Mississippi River, although they showed improvement in most sections, while moisture was insufficient from the upper Mississippi Valley eastward. Ranges showed marked improvement in the Great Plains States and the central Rocky Mountain districts, where moisture was sufficient; stock did well in these areas. The range was variable, however, in the Southwest, and was mostly poor to only fair in New Mexico, with about the normal seasonal deterioration in Arizona. Ranges, pastures, and stock did well in the more northwestern States.

A cool wave overspread the Central and Northern States about the close of the first decade of the month, with freezing weather extending southward to southwest Virginia and to the Ohio River. Fruits escaped damage largely from frost although some early varieties were injured to some extent over a wide area from the upper Great Plains eastward. There was also some local frost damage in the more western States. Otherwise the month was generally favorable for fruit.